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Technoscience as heritage in the classroom

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***Abstract*— The heritage of the Technical University of Denmark (DTU) is not easily explained. There is a real temptation to blackbox the technology in itself. The History of Technology division is exploring ways to keep the box open and translate the workings of the technology and the explanations of the scientists. A study of the process of emergence, spread, impact and perhaps closure of the technology Flow Injection Analysis has been undertaken. It a story of multiplicity and it takes many twists and turns and includes a lot of difficult science. We decided to find a way to bring this story into the high-school classroom. The FIA technology is explained by letting the students explore and use a specific FIA machine in a virtual lab. We also wanted to introduce the findings in our historical exploration of FIA. This is done by telling the student several different narratives relating to FIA or other historical technoscience developments. The students work through one or more scenarios and make decisions and debate. Our theory was, that they would use some of the apparatus they have gained from the narratives in the decision making process. In this talk I will revise the outcomes of this process.**

Index Terms *Virtual lab*

I. INTRODUCTION

The Technical University of Denmark (DTU) actively collects it’s own heritage and has a wonderful historical collection full of fantastic stories. The History of Technology group at DTU aspires to use this collection in communication products for general audiences. But most of the collection is very difficult to explain. It is tempting to just tell the compelling narratives and leave out the difficult ontology of science and technology. However, ontology is important in the stories and we are exploring ways to keep the blackbox open.

This paper will describe a specific project based on a chemical platform technology called Flow Injection Analysis (FIA). Previous to collecting material from the development of FIA technology for the historical collection, we had not heard about it before and we had some difficulty getting our heads round it. In this paper I will not attempt to explain what FIA is except saying, that the development of FIA was clearly a story about technoscience. Hence in FIA science and technology are deeply intertwined and develop together. It is impossible to say where one starts and the other ends. A historical study showed that FIA had a role in history of the modern world, but it did not have a simple correlation to everyday life or the great narratives of our modern world. But if we estimate the significance of a technology by use, as recommended by Edgerton [1], FIA is important. Two features made us pick the FIA technology for an interpretation project. It had a somewhat interesting narrative about humans and the prototypes were made from Lego. The Lego was recognizable to all observes and could perhaps work as a boundary object [2] between the technology and the audience?

II. GOING DIGITAL

We decided to aim for an online digital product for high school science classes and the whole thing should take place in the classrooms at schools. Being online would give our product a large reach as the schools would not have to travel to take part. Working in a classroom meant that the pupils could concentrate more than in an exhibition. A high school level audience was also highly attractive for our home university. Hopefully, our product would help raise the interest in our university. It became our ambition to create an engaging product, which would entice the youngsters to take part. We decided on gaming format. Computer gaming is very popular with this group and we wanted to tap into this.

III. MANAGING AND MESSAGES

We started to develop the product, a funding plan and the design team. We involved a professional developer of science communication products for high school. The developer helped identify and sharpen our main messages and she took the role of production and administrative manager, leaving the history group to what we did best – content.

The interpretation product should do several things. It had to communicate the results of a historical exploration of the FIA technology as well as explain the science and technology behind FIA and show the application of FIA. The historical study showed a process of emergence, spread and absorption of the FIA technology, but also a scientific theoretical development as part of the process. Trying to cover all this, the history group made a long list of messages, but the developer told us in no uncertain terms to cut it down.

We also set overall aims of the interpretation:
1. Explore ways to express the explanations of the scientists of how they perceive the knowledge and/or technology. 2. The history and heritage from DTU points to multiplicities in stories of the processes of science and technologies. We will explore ways to express these multiplicities. 3. Explore ways

to inspire the audience to think for themselves. Which tools helps them? 4. Explore ways to place history and heritage into new places. 5. Explore ways to co-produce with actors who took part in the original events. What can we co-produce? 6. Explore the outcomes of the process and audience experiences.

IV. CURRICULUM RULES TYPE

High school has a demanding curriculum and high school teachers only choose to use teaching material, which delivers on specific parts of the curriculum. We chose to target chemistry teaching in the second and third year and the history of technology subject, which was taught at technical High Schools. To ensure that our product would fit classroom needs and practices, we developed the product together with high school teachers, who were offered pay for the work. We considered teachers as an important target group. They had to choose to use the product and in our final product we made great efforts to explain how the teachers can use the product and which parts of the curriculum it covers. Staying within curriculums had implications for the overall design of the product. The history group had hoped to integrate the history content and science content completely, but this was abandoned. It would be very costly and it would not fit with the high school curriculum. Instead, we made a virtual lab with a short historical introduction and a separate history and sociology part.

V. DESIGNING THE VIRTUAL LAB

In the virtual lab the pupils would use the FIA technology. We used the software company Labster, which is experienced in making game style labs for high school teaching, such as a CSI lab for genome sequencing [3]. Labster has a lot of standard code, which keep costs down.

It was our ambition that the application of FIA technology in the lab should be based on a real life application and be connected to an issue, which would interest high school students. In the search for an application the history group involved scientists, who had developed or used FIA technology. However, struggling to understand the level of theoretical knowledge of this specific audience, most suggestions from the scientists involved very difficult theory. After a lot of searching and considerations we used a study of caffeine content in different foods, a substance which is well-known and consumed daily by many Danish youngsters. Again caffeine was a boundary topic, which would give the students a familiar anchor in dealing with a very unfamiliar technology. To our disappointment the caffeine study only used parts of the FIA technology, but it was manageable within the curriculum. It was close enough to highlight some key points.

In the lab the students were to test the caffeine content in different foods using a FIA-method and analyze the results. The pupils also went through the principles of the FIA-method, acquired knowledge of the substance caffeine and the effects of caffeine. Along the way the pupils got points depending on how well they solved the tasks.

An experienced science teacher wrote a draft of the theory, questions and exercises, which the pupils would solve on their way through the lab. The developer reworked the text in collaboration with the teacher. Text and exercises would appear on a lab pad as the pupils went through the lab and the students could also consult the theory text whenever they wanted. On the lab pad we used multiple choice with four possible answers. The answers reshuffled if the students picked the wrong answer and the students achieved fewer points with each click on wrong answers. We had hoped to make a simulation allowing the students to assemble a FIA-instrument using Lego-bricks to create a connection with the prototypes in the historical collections. But this had serious copyright implications and was abandoned.

VI. TESTING THE VIRTUAL LAB

The lab was tested with three separate groups in the setting of their own classrooms. We observed while the students worked through the lab experience and at the end they filled in a questionnaire. The first tests divulged many issues. Some issues were shared by many users, but the students also had individual experiences. An animation which made perfect sense to one student was difficult for another and according to the teacher this was not just a matter individual academic abilities. Individual learning styles could also be at play. The animations are very visual and this will not fit all learning styles. A general issue was, that the product had come to close to book learning on a screen. We needed to add more of the feel of struggling with a technology in a lab, which was what we felt that the digital product could add. Having rewamped the lab, another test run was carried out and a lot of issues appeared to have been resolved.

During the tests we paid close attention to the effect of giving points, which was believed to add a feeling of playing a game. The competitive issue of point giving appeared to appeal to some students, who according to the teacher were far more motivated than in a normal setting, while others found it annoying or meaningless. Generally our observations and the questionnaire showed that the students were motivated by the virtual lab, intuitively understood how to use the lab and achieved a good understanding of the technology and the science through the animations and explanations.

VII. HISTORY

After a host of deliberations we decided to work with the history part in a very different way. The historical study had revealed very complex developments. The history group wanted the students to explore the multiplicity of the FIA story and the processes involved in technoscience as well as provide the pupils with tools to analyze technoscience. The history group had a great many messages, but the developer helped us cut the massive list down to five focus areas. We wanted the pupils to debate and contemplate dilemmas. We hoped, that dialog would stimulate cognitive redefinition [4]. We chose to focus on ten specific topics and wrote ten short narratives for the students, a fictitious case and a role play. To support the process we also made short videos of experts lecturing and a short intro text for the students. The texts were kept very short, as the pupils should be able to read them in class. The text was formulated in everyday and colloquial language. We also produced a short plan for the teachers. In the teaching plan we recommended that all pupils read the case focused on FIA as it introduced some central concepts together with the background text. The other narratives feed on well-known technologies or scientific discoveries [4]. We recommended that the teacher would then pick a couple of cases that the students would work through in small groups. The pupils were asked to identify which of the five focus areas characterized the case. All cases were accompanied by a few questions for the students to contemplate.

VIII. A TEST OF HISTORY

The history part was tested with around 25 students during a history of technology class in a technical high school. We were very interested to see if the students would be able to read and understand the texts in class and if the texts offered enough info to allow discussions. We were very happy to observe that this seemed to be the case. The students had very good debates using the focus areas. The dilemmas appeared to inspire them. We also wondered if we were steering too much. There is a serious ethical issue in presenting a complex story as a simple question dependent only on a few features of our world [4].

But the students showed great ability in going beyond the information provided in the texts. Listening in on conversations, it was quite clear that the students were able to think for themselves. Dilemmas appeared to be a good tool.

Our hope was that teachers would use both the virtual lab and the history part together. However, our two science teachers seemed somewhat uninterested in the history part and the history teacher was not interested in the chemistry. Also, a meeting with two other history teachers gave us the same feel. We were not able to test this and have not learned of any experiences using these two parts together.

IX. WHAT DID WE LEARN?

We had set a number of aims for the FIA product. We did find a way to express some of the explanations of the scientists, much helped by animations and simulations. But this had to be adapted to the high school curriculum. In the history part the students clearly got the multiplicities in the stories.

They were also clearly inspired to think for themselves through the dilemmas but also to use the tools given to them. We only partly manage to place history and heritage in new places as then only made cameo appearances in the virtual lab. The scientists did co-produce with us, but they were demotivated by the constraints of the curriculum.

Do the students learn more in the virtual lab than they could through book learning? The answer to this is yes. The digital animations are great tools for learning and the students could do work which would have been impossible in a school lab.

A team with different skill-sets proved important. It helped the project stay on track and keeping focus on the audience.

Historical material did play a direct role, but mainly through images. Historical objects were shown, but did not play a significant role.

REFERENCES

[1] D. Edgerton, The shock of the old, London: Profile Books Ltd, 2006.

[2] S. Leigh Star and J.R. Griesemer, “Institutional ecology, ‘translations’ & boundary objects: Amateurs and professionals in Berkeley’s Museum of Vertebrate Zoology”, in: Social Studies of Science, 1907-1939, pp. 387-420.

[3] M. Bodekaer, “What CSI Can Teach Students about DNA Sequencing”, in: Blog, Virtual Labs, Virtual Reality, May 28 2015, available at <https://www.labster.com/what-csi-can-teach-students-about-dna-sequencing/>, accessed 22 May 2017.

[4] S.Høyrup, “Læringslaboratorier og – areaner: På jagt efter de optimale læringsrum”, in: Læringslaboratorier og – eksperimenter. D. Staunæs, H.K. Adriansen, K. Dupret, S. Høyrup og N.C.M, Nickelsen eds., Aarhus: Aarhus Universitetsforlag, 2014, pp. 40-50.